

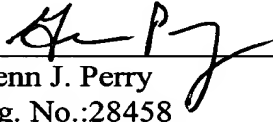
**REMARKS**

Entry of the foregoing amendments is respectfully requested. The specification and claims have been amended to correct informalities only. No new subject matter has been added. An early and favorable first Action on the merits is earnestly solicited.

Attached hereto is a marked-up version of the changes made to the specification and claims by the current amendment. The attached Appendix is captioned **"Version with markings to show changes made"**.

Respectfully submitted,  
Pillsbury Winthrop LLP

By: \_\_\_\_\_

  
Glenn J. Perry  
Reg. No.: 28458  
Tel. No.: (202) 861-3070  
Fax No.: (202) 822-0944

GJP\srd  
1100 New York Avenue, NW  
Ninth Floor  
Washington, DC 20005-3918  
(202) 861-3000  
Enclosure: Appendix

**APPENDIX**  
**VERSION WITH MARKINGS TO SHOW CHANGES MADE**

**IN THE SPECIFICATION:**

Page 4, line 10:

**[OBJECTS AND] SUMMARY OF THE INVENTION**

Page 18, delete the entire paragraph beginning on line 5 and replace it with the following new paragraph:

According to the present invention, the axial chief ray is defined, in the case of the observation optical system, as a ray travelling from the center of the exit pupil through the center of the observation image forming member as traced in the reverse direction, or, in the case of the photographing optical system, as a ray travelling from the center of the aperture stop through the center of the image pickup element as traced in the forward direction. The optical axis, which is defined by the straight line portion of the axial chief ray from the center of the exit pupil or of the aperture stop to the point of intersection with the second exit surface or with the third entrance surface of the second prism, is defined as Z axis. The axis that intersects Z axis at right angles and that lies in a plane of decentering for each surface constituting the second prism is defined as Y axis. The axis that intersects Z axis and Y axis at right angles is defined as X axis. The center of the exit pupil or of the aperture stop is determined as the origin of the coordinate system for the observation optical system or the photographing optical system of the present invention. Also, according to the present invention, surface arrangement numbers are assigned in order from the exit pupil through the observation image forming

member to conform to the reverse ray tracing or in order from the aperture stop through the image pickup element to conform to the forward ray tracing. The direction of the axial chief ray from the exit pupil toward the observation image forming

Page 21, delete the entire paragraph beginning on line 19 and replace it with the following new paragraph:

Here, if it is assumed that  $n [= 4]$  is from 1 to 4 (polynomial of degree 4), for example, Equation (5) is expanded as the following expression (6):

Page 24, delete the entire paragraph beginning on line 3 and replace it with the following new paragraph:

Ray tracing for a ray with wavelength  $\lambda$  incident on and emergent from any point P on the HOE surface is given by the following equation (9), which uses the optical path difference function (Do defined for a reference wavelength  $\lambda_0 = \text{HWL}$  on the HOE surface:

Page 24, delete the entire paragraph beginning on line 12 and replace it with the following new paragraph:

If the HOE is fabricated (defined) by two point light sources with the reference wavelength  $\lambda_0$ , specifically by interference between object rays emanating from the point  $P_1 = (\text{HY1}, \text{HY2}, \text{HY3})$  and reference rays emanating from the point  $P_2 = (\text{HX2}, \text{HY2}, \text{HZ2})$  as shown in FIG. 19, the following equation is satisfied:

$$\begin{aligned}\Phi_0 &= \Phi_0^{2P} \\ &= n_2 \cdot s_2 \cdot r_2 - n_1 \cdot s_1 \cdot r_1\end{aligned}$$

where  $r_1$  ( $r_2$ ) is a distance ( $> 0$ ) from the point  $P_1$  ( $P_2$ ) to a predetermined coordinate point (i.e. the origin)  $O$  on the HOE,  $n_1$  ( $n_2$ ) is a refractive index of the point  $P_1$  ( $P_2$ ) -side medium by which the HOE was arranged during fabrication (definition),  $s_1 = HV_1$ , and  $s_2 = HV_2$  are signs to take into consideration the travelling direction of light. In the case where the light source is a divergent light source (real point light source), the sign is set to be  $REA=+1$ , while in the case where the light source is a convergent light source (virtual point light source), the sign is set to be  $VIR = -1$ . It is noted that in defining a HOE in lens data, the refractive index  $n_1$  ( $n_2$ ) of the medium in

Page 33, delete the entire formula on line 26 and replace it with it the following new formula:

$$Z=[(Y_2/R)] [(Y^2/R)] / [1+\{1-P(Y^2/R^2)\}^{1/2}] + A_4 Y^4 + A_6 Y^6 + A_8 Y^8 + A_{10} Y^{10} \dots \dots (13)$$

Page 43, delete the entire formula on line 9 and replace it with the following new paragraph:

In the configuration of the first embodiment, even if bundles of rays are incident on the volume hologram 6 at the first incident angle, rays in predetermined wavelength regions fail to be subject to 100% reflection by diffraction, as shown in FIG. [20] 21, for example. A very small amount of undesired order rays, which are not reflected by diffraction, are generated, to be transmitted light.

Page 44, delete the entire paragraph beginning on line 19 and replace it with the following new paragraph:

As an example, a head-mount type binocular image display apparatus is shown in FIG. 8, as it is fit to the head of an observer, and in FIG. 9 in the form of a sectional view. As shown in FIG. [10] 9, this apparatus is configured to use the observation optical system according to the present invention as an eyepiece optical system 100 provided with an image display element 5. A pair of such eyepiece optical systems 100 are provided and held spaced away from each other by the interpupillary distance, to form a stationary type or portable type image display apparatus 102 such as a head-mount type image display apparatus for binocular

Page 46, delete the entire paragraph beginning on line 8 and delete it with the following new paragraph:

Also, the observation optical system according to the present invention may be applied to a head-mount type monocular image display apparatus, which is designed so that an eyepiece optical system is held in front of either eye of an observer. FIG. 10 shows the condition where the monocular image display apparatus is held to the head (in the drawing, in front of the left eye) of the observer. In this configuration, a main frame 102 which is provided with a set including an eyepiece optical system 100 and an image display element 5 is mounted on a front frame 108 at a position in front of the corresponding eye. Side-head frames 103 shown in the figure are coupled to the front frame [107] 108 on the lateral sides thereof so as to hold the main frame 102 in front of the odd eye of the observer. Other features are similar to those of the foregoing

binocular configuration shown in FIG. 8, and thus explanation about them is omitted here.

IN THE CLAIMS:

23. (Amended) A photographing optical system according to claim 2, wherein a ghost light removing member is provided for optically non-operative faces of said first prism and said second prism so as to prevent ghost light from being introduced to [an eye of an observer] said image pickup element, said optically non-operative faces being defined as faces of said first prism and said second prism other than optically operative faces used to transmit or reflect rays.

29. (Amended) A photographing optical system according to claim 2, wherein said third entrance surface of said second prism is shaped as a rotationally asymmetric curved surface that has an action of compensating at least one of rotationally asymmetric aberrations including a rotationally asymmetric coma and a rotationally asymmetric astigmatism, which are generated at said [eyepiece] imaging optical member.

30. (Amended) A photographing optical system according to claim 2, wherein said third entrance surface of said second prism is shaped as a rotationally asymmetric curved surface that has an action of compensating at least one of rotationally asymmetric aberrations including a rotationally asymmetric coma and a rotationally asymmetric astigmatism, which are generated at said [eyepiece] imaging optical member, and said rotationally asymmetric curved surface is constructed of a free curved surface defining only one plane of symmetry, said only one plane of symmetry coinciding with a plane (Y-Z plane) in which an optical axis is folded.